CLAIMS

1. Device for producing a radioisotope of interest from a target fluid irradiated with a beam of accelerated charged particles, said device comprising in a circulation circuit (17):

- an irradiation cell (1) comprising a metallic insert (2) able to form a cavity (8) designed to house the target fluid and closed by an irradiation window (7), said cavity (8) comprising at least one inlet (4) and at least one outlet (5);
- a pump (16) for circulating the target fluid inside the circulation circuit (17);
- an external heat exchanger (15);

said pump (16) and said external heat exchanger (15) forming external cooling means of said target fluid;

said device being characterized in that it further comprises pressurizing means (14) of said circulation circuit (17) and the external cooling means of said target fluid are arranged in such a way that the target fluid remains inside the cavity (8) essentially in the liquid state during the irradiation.

2. The device according to claim 1, characterised in that said pump (16) generates a flow rate sufficient to keep the target fluid at a mean temperature below 130°C.

3. The device according to claim 1 or 2, characterised in that said pump (16) generates a flow rate greater than 200 ml/minute.

4. The device according to any one of the preceding claims, characterised in that said pump generates a flow rate greater than 500 ml/minute,

preferably greater than 1000 ml/minute, and more preferably greater than 1500 ml/minute.

5. The device according to any one of the preceding claims, characterised in that said cavity (8) is able to contain a volume of target fluid of between 0.2 and 5.0 ml.

6. The device according to any one of the preceding claims, characterized in that it is configured so as to contain in its circulation circuit (17) an overall volume of the target fluid that is less than 20 ml.

7. The device according to any one of the preceding claims, characterized in that the inlet (4) and outlet (5) are arranged in such a way as to create a vortex in the flow of the target fluid inside said cavity (8).

8. The device according to any one of the preceding claims, characterized in that one of the inlet (4) or the outlet (5) is positioned essentially tangentially to said cavity (8).

9. The device according to any one of the preceding claims, characterized in that the inlet and the outlet are located at the lateral surface of the cavity (8), on the same meridian.

10. The device according to any one of claims 1 to 9, characterized in that the inlet (4) is arranged so that the target fluid inflow is directed at a impact point of the accelerated charged particle beam in the cavity window (7) in such a manner that said inflow hits said window head-on with said beam.

11. The device according to any one of claims 1 to 10, characterized in that the cavity (8) presents a central axis (x-x) around which a lateral surface is developed, the outlet (5) being connected to

said lateral surface and the inlet (4) being along said central axis.

12. The device according to any one of the preceding claims, characterized in that said irradiation cell (1) comprises internal cooling means.

13. The device according to any one of the preceding claims, characterized in that said internal cooling means are in the form of a double-walled jacket surrounding said cavity (8).

14. The device according to claim 12 or 13, characterized in that said internal cooling means are indirect cooling means of the cavity (8).

15. The device according to any one of the preceding claims, characterized in that it comprises Helium-based cooling means for cooling the irradiation window (7) of the irradiation cell (1).

16. A method for producing a radioisotope of interest from a target fluid used as precursor of said radioisotope of interest irradiated inside an irradiation cell with a beam of accelerated charged particles, said irradiation cell (1) comprising an metallic insert (2), able to form a cavity (8) designed to house the target fluid and closed by an irradiation window (7), said cavity (8) being provided with at least one inlet (4) and at least one outlet (5);
said method being characterized in that said target fluid circulates inside in a circulation circuit (17) which comprises in addition to the irradiation cell (1), at least a pump (16) for the circulation of the material and an external heat exchanger (15);
said method being further characterized in that the pressure of the circuit is controlled by means of a pressurizing means (14) of said circulation circuit and in that said pump (16) and said external heat exchanger

(15) are arranged in such a way that the target fluid remains inside the cavity (8) essentially in the liquid state during the irradiation.

17. The method according to claim 16, characterized in that a vortex in the flow of the target fluid is induced inside said cavity (8).

18. The method according to claim 16 or 17, characterized in that the pump (16) generates a flow rate sufficient to keep the target fluid at a mean temperature below 130°C.

19. The method according to claim 18, characterised in that the pump (16) generates a flow rate greater than 200 ml/minute.

20. An irradiation cell (1) comprising a metallic insert (2), able to form a cavity (8) designed to house a target fluid and comprising at least one inlet (4) and at least one outlet (5), said cavity (8) being defined by a central axis around which a lateral surface is developed, and said cavity (8) being closed by an irradiation window (7) and being closed by a second surface essentially perpendicular to the central axis and opposed to the irradiation window (7),
said irradiation cell being characterized in that the inlet is connected to said second surface essentially perpendicular to said central axis, while the outlet is connected to the lateral surface.

21. Use of the device according to any one of the claims 1 to 15 or of the method according to any one of the claims 16 to 19 or the irradiation cell according to claim 20 for manufacturing a radiopharmaceutical compound, in particular devoted to medical applications such as positron emission tomography.